PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Multi-Stage Radial Flow Compressors, Turbines and Pumps

We, SULZER FRERES, SOCIÉTÉ ANONYME, a Company organised under the Laws of Switzerland, of Winterthur, Switzerland, do hereby declare this invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the manufacture of multi-stage radial flow turbo machines, which expression is intended to embrace multi-stage radial flow compressors, turbines and pumps, The invention is particularly suitable for the manufacture of multi-stage radial flow suction pumps such as are used in paper making machines, but it can also be applied to multi-stage radial flow turbo machines for other purposes.

Hitherto, in the manufacture of a multi-stage radial flow turbo machine the casing, including a deflecting part bounding the channels which conduct the working fluid from one stage to the next, at least one inter-stage connection (i.e. an inter-stage inlet or outlet), and the aperture or apertures through the deflecting parts necessary for connecting the inter-stage connection or connections to the appropriate deflecting channel or channels, have all been cast in one operation.

According to the present invention, a method of manufacturing multi-stage radial flow turbo machines each having stationary deflecting parts bounding the channels which conduct the working fluid from one stage to the next and each having at least one inter-stage connection, includes carrying out the following steps in succession;

(a) making, in series, a plurality of machines each with a double walled casing which forms at least one annular passage surrounding the deflecting parts of at least two stages and communicating with the inter-stage connection or connections; and

(b) individually forming at least one aperture through at least one of the deflecting parts at a point or points selected to suit the requirements of the individual machines.

This new method of manufacture makes it possible to carry out an important and time-consuming part of the manufacturing process, namely the casting of the casing, without regard to what particular apertures may be required in the finished machine between the inter-stage connection or connections and the channels bounded by the deflecting parts, and which may vary in machines required for different duties. After step (a) of the method has been performed several identical machine casings are available which only require minor finishing operations and assembly to complete the machines. These casings can be kept in stock in this condition. When a machine having a particular duty is to be completed, one or more apertures can be formed between the inter-stage connection or connections and one or more channels bounded by the deflecting parts as required to suit this duty, and the assembly completed in a short time. Delivery time is thus shortened and delivery dates can be kept more easily. Moreover, the manufacture of the casings can be carried out at convenient times, e.g. when adequate labour is available, before detailed knowledge of the particular duties of the machines is available. Thus expensive individual production of complete machines can be largely avoided.

Preferably, in step (a) the deflecting parts of each machine are provided with at least one relatively thin area adjacent to at least one channel, and in step (b) the aperture (or apertures) required is (or are) formed by punching out or boring through at least one thin area.

In applying the method to the manufacture of turbo machines having at least two inter-stage connections, in step (a) at least one transverse partition may be provided in each casing between the double walls to form at least two annular passages each communicating with a separate inter-stage connection. With such casings, where at least one of the inter-stage connections will not be required in the finished machine no aperture is formed in

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the deflecting parts surrounded by the annular passage or passages associated with the unwanted inter-stage connection or connections. The machine will then have at least one dead inter-stage connection. On the other hand, for machines where all the inter-stage connections will be required, the step (b) will include forming at least one aperture in at least one of the deflecting parts surrounded by each annular passage. The machine will then have no dead inter-stage connections, since all these connections will communicate with the channels bounded by the deflecting parts.

The invention also embraces multi-stage radial flow turbo machines made by the method of the invention.

The invention may be performed in various ways and one particular turbo machine and its method of manufacture embodying the invention will now be specifically described by way of example with reference to the accompanying drawing, which is a longitudinal section through the completed machine.

The turbo machine shown in the drawing is a five stage radial flow suction pump having a main suction pipe 1, two inter-stage suction connections 2 and 3 providing a smaller degree of suction than that provided by the main inlet, and a discharge pipe 4. The casing 5 is a double walled casing comprising an outer wall 6 and deflecting parts 7, 7*a*, 7*b* and 7*c* which bound the channels which conduct the working fluid from one stage to the next. The annular space between the outer wall and the deflecting parts of the casing is divided by means of a transverse partition 10 into two annular passages 8 and 9 with which communicate respectively the inter-stage connections 2 and 3.

When a machine of a particular duty is to be completed and it has been decided for this particular machine which of the annular spaces 8 and 9 is to communicate with which of the channels bounded by the deflecting parts, one or more apertures is formed between either or both of the annular spaces 8 or 9 and the appropriate channel or channels. In the particular machine illustrated apertures 11*a* and 11*b* have been formed so that the annular space 8 is in communication with the channel 12*a* and the annular space 9 is in communication with the channel 12*b*. Thus in the completed machine there prevails in the inter-stage connection 2 the suction head that is created in the channel 12*a* between the second and third stages, while in the inter-stage connection 3 there prevails the suction head that is created in the channel 12*b* between the third and fourth stages.

The method of manufacture of the machine illustrated included the two stages (a) and (b). In the first step (a) the casing was made as one of a batch of identical casings without any apertures in the deflecting parts 7, 7*a*, 7*b* and 7*c*. Then, when this machine of a given duty was to be completed, the step (b) was performed by making the apertures 11*a* and 11*b*.

In a modified design and method of manufacture the deflecting parts 7, 7*a*, 7*b* and 7*c* are all provided in step (a) with thin areas at points adjacent to the channels, for instance at points corresponding to those at which the apertures 11*a* and 11*b* appear in the drawing. Then in step (b) the required apertures are made by punching out or boring through the appropriate thin areas.

What we claim is:—

1. A method of manufacturing multi-stage radial flow turbo machines each having stationary deflecting parts bounding the channels which conduct the working fluid from one stage to the next and each having at least one interstage connection, which method includes carrying out the following steps in succession;

(a) making, in series, a plurality of machines each with a double walled casing which forms at least one annular passage each surrounding the deflecting parts of at least two stages and communicating with the inter-stage connection or connections; and

(b) individually forming at least one aperture through at least one of the deflecting parts at a point or points selected to suit the requirements of the individual machines.

2. A method as claimed in Claim 1 wherein in step (a) the deflecting parts of each machine are provided with at least one relatively thin area adjacent to at least one channel, and in step (b) the aperture (or apertures) required is (or are) formed by punching out at least one thin area.

3. A method as claimed in Claim 1 wherein in step (a) the deflecting parts of each machine are provided with at least one relatively thin area adjacent to at least one channel, and in step (b) the said aperture (or apertures) is (or are) formed by boring through at least one thin area.

4. A method as claimed in Claim 1 or Claim 2 or Claim 3 wherein in step (a) at least one transverse partition is provided in each casing between the double walls to form at least two annular passages each communicating with a separate inter-stage connection.

5. A method as claimed in Claim 4 for manufacturing a machine in which at least one of the inter-stage connections is not required, wherein no aperture is formed in the deflecting parts surrounded by the annular passage or passages associated with the unwanted inter-stage connection or connections.

6. A method as claimed in Claim 4 wherein in step (b) includes forming at least one aperture leading from each annular passage.

7. A method of manufacturing a multi-stage radial flow turbo machine substantially as specifically described with reference to the accompanying drawing.

8. A multi-stage radial flow turbo machine manufactured by a method as claimed in any of the preceding claims.

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Agents for the Applicants.

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1 SHEET

This drawing is a reproduction of the Original on a reduced scale.